Artful Surfaces: An Ethnographic Study Exploring the Use of Space in Design Studios

Abstract

A largely overlooked aspect of creative design practices is how physical space in design studios plays a role in supporting designers' everyday work. In particular, studio surfaces such as designers' desks, office walls, notice boards, clipboards and drawing boards are full of informative, inspirational and creative artefacts such as, sketches, drawings, posters, story-boards and post-it notes. Studio surfaces are not just the carriers of information but importantly they are sites of methodic design practices, i.e. they indicate, to an extent, how design is being carried out. This article describes the results of an ethnographic study on the use of workplace surfaces in design studios, from two academic design departments. Using the field study results, the article introduces an idea of 'artful surfaces'. Artful surfaces emphasize on how artfully designers integrate these surfaces into their everyday work and how the organization of these surfaces comes about helping designers in accomplishing their creative and innovative design practices. Using examples from the field study, the article shows that artful surfaces have both functional and inspirational characteristics. From the field study, three types of artful surfaces are identified: personal, shared and project-specific. The article suggests that a greater insight into how these artful surfaces are created and used could lead to better design of novel display technologies to support designers' everyday work.

Keywords: Ethnography, Design Studio Culture, Artefacts, Space, Design

1 INTRODUCTION

"*Space is a resource that must be managed, much like time, memory, and energy. When we use space well we can often bring the time and memory demands of our tasks down to workable levels. We can increase the reliability of execution, and the number of jobs we can handle at once*."

- David Kirsh (1995)

Space and spatial arrangements play an important role in our everyday social interactions. The way we use and manage our surrounding space is not coincidental, on the contrary, it reflects the way we think, plan and act. Within collaborative contexts, its ability to support social activities makes space an important component of human cognition in the post-cognition era. To some extent space can be seen as a technology that we use to support our actions. The use of space has become so implicit in our everyday lives that we do not realize how it helps in our thinking, planning and other behavior. Kirsh's (1995) work has been very much focused on the way we intelligently utilize physical space. His findings highlight the fact that intelligent use of space can lead to effective performance by humans by providing selective attention, longer memory span, facilitated perception and choice. Humans intelligently adopt environmental resources as a means of bridging the gap that separates them from a desired solution.

For the purpose of informing the design of collaborative tools in design studios, an ethnographic field study was carried out in two educational industrial design studios. This article presents the results of the field study, specifically, focusing on the spatial aspects. The design studio is an interesting case for studying the use of space. The concept of studio-based work has been central to practices as well as education within design disciplines such as architecture and industrial design for over a century (Fallman, 2007). A typical design studio (Figure 1) has a high visual and material character – in the sense that it is full of material objects and design artefacts; studio walls and other less permanent vertical surfaces are full of post-it notes, sketches, posters and magazine clips for sharing ideas and inspiration; physical models and prototypes are lying on the desks. Many of the objects in a design studio may have seemingly little to do with the projects on hand, but in fact serve to challenge and inspire new ideas, to create cross-contextual reminders that lead to breakthrough thinking and conceptualization (Blevis et al. 2007). The physical surroundings of a design studio and the persistence with which different material artefacts are arranged and represented are important to the design activity and serve as 'organizational memory' (Ackerman and Halverson, 1995) and 'distributed cognition' (Hutchins, 1995) for design teams. This ecological richness of design studios stimulates creativity in a manner that is useful and relevant to the ongoing design tasks. The studio space is important for supporting and inviting design critiques (Uluoglu, 2000) and the strongly ingrained designerly practice of showing work and eliciting feedback early and often (Cross, 2006). Such practice encourages discourse and reflection during the design process (Schön, 1983). Moreover, in design studios much of the design work is collaborative and group-oriented and the physical nature of design studios can easily afford group-orientation and collaborations. Overall, the physical setting of the design studio is typically meant to emphasize and stimulate communication, collaboration, and sharing. The spatial aspects of design studios promote a style of learning that is based on continuous dialogue, conversation and critiquing each other's work.

Fig 1. A studio workspace full of artful surfaces

Additionally, designers do not work in a stereotypical or mechanical fashion when designing interactive products. Designers tend to be innovative, creative and often playful in order to collaborate and successfully meet the demands of building new products and services. As Lawson (1979) puts it, designers use 'synthesis' when it comes to problem-solving, whereas traditional scientists use 'analysis'. Designers' way of thinking focuses on quickly developing a set of satisfactory solutions, rather than, producing prolonged analysis of a problem (Cross, 2006). Keeping this in mind, the design community has been working on developing tools (e.g. Electronic Cocktail Napkin (Gross, 1996)) that do not demand great effort, commitment or precision and allow quicker production of their design ideas. Instead of using optimization in their work, designers use methods by which they can produce a set of results, all of which might satisfy a given problem or a problematic situation. As a result, designers frequently use and produce a relatively high number of representations such as, design sketches, drawings, storyboards, and collages, amongst other things. Moreover, methods frequently used by designers such as role playing (Boess, 2008), body storming and design choreography (Klooster and Overbeeke, 2005) are not limited to problem solving but also include understanding interactional, aesthetic and experiential qualities in designing interactive products.

Studies on the role of physical space in design studios have been rare in the design community. This is not because spatial aspects in design studios are less relevant or important; on the contrary, the use of physical space has been so implicit in this context that it has for long been taken for granted in the design discipline. In this article, the results of an ethnographic field study in two academic industrial design departments are presented, where we studied the role of physical space – in particular studio surfaces. We believe that there are three main advantages of carrying out such a study. First, we can collect a much richer understanding of design practices – especially getting access to more implicit and tacit phenomena such as the use of physical space. The article strongly emphasizes the role of surfaces in offering resources for social, organizational and individual activity that designers routinely encounter and use on an everyday basis. Studio surfaces are not just the carriers of design-related information but importantly they are sites of methodic design practices. Hence, an understanding of the use of space can tell us how design is practiced. Second, a study about physical space would bring new insights into how creativity can be fuelled into work organizations, not only in the design studio context but also for other domains of work. Due to

globalization and international competition, organizations' performance is becoming increasingly dependant on creativity and innovation. An increasing number of studies have shown that the physical setup of work organization plays an important role in supporting innovation and creativity (e.g. Kristensen, 2004; McCoy and Evans, 2002). It might not be easy to establish a 'direct' connection between designers' creativity and their physical space but such a study could provide some useful insights into the connection itself. Third, from a Human Computer Interaction (HCI) perspective, an understanding of studio surfaces can lead to the development of new technological tools that can support 'designerly' communication. With a broader aim, we are also interested in exploring the possibilities of new technologies that could take into account the social practices of designers. Our main intention for carrying this kind of field study is to inform the design of new display technologies by learning lessons about how physical surfaces in the design studios are used.

Using the field study results, in this article, we introduce the idea of *artful surfaces* – surfaces that designers create by externalizing their work-related activities, to be able to effectively support their everyday way of working. From longitudinal field study in two academic departments of industrial design, a simple classification of artful surfaces is developed: personal, shared, and project-specific surfaces. Using examples from the field, the article explores what these surfaces are like and what purpose they serve. Secondly, the article illustrates the dual nature of these surfaces. On the one hand these surfaces help designers to organize their work and be accountable to it through allowing them, for example, to create to-do lists, to write timetables, and to make charts for the division of work. On the other hand, these surfaces also have an inspirational role as they allow designers to reflect their social identity, and to collect inspirational, personal and creative sources of information. Hence, artefacts in general not only improve efficiency or have a purely functional role, but the presence and different manifestations of these surfaces bring quality and richness to designers' performance and help in making better sense of their everyday lives. For designers this inspirational role of artful surfaces is as important as the functional and productivity related role. The former is often neglected in the study of design practices.

In the rest of this article, we first describe a subset of related literature, focusing on the role of physical space in work organizations, and in particular design studios. Next, we discuss the approach and methods used in our ethnomethodologically-informed field study. Next, the results of the field study are described and three classes of artful surfaces are identified. Finally the article provides a short discussion on our results.

2 RELATED WORK

The role of physical space in design studios and how it affects design practices has not been studied in detail within the design discipline, with a few exceptions, described in the following, where this topic is merely touched in a periphery.

Tom Allen (1997) studied the effects of physical layout on the probability of interaction in research laboratories and product development firms. His results showed that the relationship between the probability of two people interacting and the physical distance between them was strongly negative ($r = -0.84$). In some cases, research has also illustrated that ill-considered construction of design studio space could lead to a negative impact on designers' creativity (Leonard and Swap, 1999). As John Seiler points out, "buildings influence behavior by structuring relationships among members of the organization. They encourage some communication patterns and discourage others. They assign positions of importance to units of the organization. They have effects on behavior, planned or not" (Seiler, 1984). Agility and flexibility in design studios are also found to be important in some of the studies. The book by Horgen, Joroff, Porter and Schön (1999) refers to the flexibility in design studios as 'workplace making'. The authors suggest that workplace making is a continuing effort of improving and changing basic assumptions about work practices and physical workspace to suit the current needs of design

projects. They call for design studios that are much more flexible and adaptive to designers' needs. Agility is another aspect that is seen as designers' ability to quickly respond and effectively make rapid changes in an uncertain situation. In the design studio context the readiness-to-change physical settings is seen to be imperative. Exploring the success of a well known design company called IDEO, Kelly and Littman (2001) suggest that despite the fact that all IDEO offices have a similar feeling and layout, "one can easy tell it's an IDEO office, each office creates and enacts a distinctive environment. The team dynamics changes with projects, and thus, there is a continuing rearrangement of teams, project spaces and neighborhoods." To the authors, the flexibility of physical studio spaces is enough to support IDEO's creative practices.

Kuhn (1998) suggests that the physical space in architectural studios should be arranged in such a way that designers can 1) deal with open-ended problems, 2) carry out rapid design iterations, 3) use heterogeneous media, 4) support formal and informal critiques, and 5) making creative use of constraints. Schön's (1983) seminal work conceptualizes designing as a kind of experimentation that consists in reflective 'conversation' with the materials of a design situation. He suggests that this reflective practice involves a continuous process of seeing-moving-seeing (Schön and Wiggins, 1992). Schön's work does not explicitly make a case for the importance of the physical space in studios, but a certain organization and arrangement of design studio spaces can greatly support reflective practices. The study of Sachs (1999) suggests that in traditional practices of architectural and design students, the emphasis is placed on the progress of creating multiple design artefacts and representations. Hence, progress is expected to be visible as a sequence of design artefacts such as drawings, sketches, storyboards and models – each expanding upon the information in its predecessors. Design artefacts often used and produced during design practices such as paper drawings, physical or graphical models can serve as representations of cooperative work. Once design artefacts are attached to the space, the materiality, stigmergy, public availability and knowledge landmarks of these artefacts help in supporting communication and coordination amongst design teams. European projects such as DESARTE (Büscher et al. 1999) and ATELIER (Jacucci and Wagner, 2003; Schmidt and Wagner, 2002) have been primarily focusing on understanding the role of physical space within design and architectural studios. Results of their ethnographic studies have provided useful insights into the 'customizability' of physical workspaces. These studies focusing on architectural design studios explore the 'communicational' role of space in design studios.

It is also important to understand how the notion of space is utilized in other domains of work. The following is a very brief account of the related literatures found in the fields of Human-Computer Interaction (HCI) and Computer Supported Cooperative Work (CSCW).

Several ethnographic studies have demonstrated the importance of vertical and horizontal surfaces in professional and domestic environments. One of the most influential studies related to the use of physical space was carried out by David Kirsh (1995). Drawing results from videos of cooking, assembly and packing, interactions in supermarkets, and experimental studies of computer games, Kirsh proposed three main advantages of utilizing space: simplify choice; simplify perception; simplify internal computation. He suggested that people utilize techniques which would reduce the memory load of tasks, the amount of internal computation necessary, or which simplify the visual search and categorization that might inevitably be involved in performance. Perry and O'Hara (2003) studied display-based activities in various office spaces and developed a taxonomy characterizing three valuable aspects of these displays: ready access to information, social orientation and coordination and planning. Within the domain of healthcare, it has been shown that vertical displays such as notice boards in the public environment of hospitals help medical doctors and nurses to coordinate their work (Bardram, 2005). The public availability supported by these vertical displays has proved to be useful also in other professional domains. A large corpus of research

related to public availability and use of situated displays can be found in (O'Hara et al., 2003). In the case of domestic environments, Swan and Taylor (2005) have studied fridge surfaces and have shown that the re-configurability and portability of different informational artefacts on the fridge surface have strong implications for supporting and negotiating family relationships. The authors' ethnographic studies of photo display practices in homes have shown that the way people organize their vertical photo displays in homes also reflects the expressions they want to convey (Swan and Taylor, 2007). Kidd's (1994) classical study on knowledge workers shows that the spatial layout afforded by horizontal surfaces (in her case, populated with different material artefacts, for example, papers and files) such as office desks and office floors work as holding patterns and provide contextual cues about the overall progress of work. Sellen and Harper (2002) show that professionals prefer to organize papers by piling them on horizontal surfaces rather than filing them. This way of storing information makes specific papers visible, which in turn serves a reminding function. A review on the importance of papers in professionals' everyday work is provided in (Randal et al. 2007). Hutchins's (1995) work on distributed cognition also suggests that these kinds of artefacts serve as external memories that could help professionals to make better sense of their work in progress.

3 APPROACH AND METHODS

To be able to understand the role of physical surfaces in design studios, one needs to get a naturalistic view on how design is practiced in design studios. Ethnography (Button, 2000; Ball and Ormerod, 2000) is often used to study social interactions and work-practices in organizations. In this field study, we have used a particular form of ethnography, called ethnomethodology (Garfrinkle, 1967). Ethnomethodology, as Button (2000) puts, "shifts the emphasis away from the production of sociological accounts and theories of social doings to an emphasis upon the description of the accountable practices involved in the production of naturally organized phenomena". Ethnomethodology provides a particular 'lens' to understand work practices as they manifest themselves in the real world, without using any preconceived notions. have used an ethnomethodological approach for understanding how industrial designers work, how they communicate with each other, and what tools, methods and approaches they use for design. The ethnomethodologically informed approach helps in understanding the 'instances' of observable practices and methods that designers apply in their everyday work which could help uncover mundane and everyday social facts.

We studied industrial design departments at two technical universities in the Netherlands. Both universities had studio-based learning facilities. In our investigation, we studied designers and design researchers as well as students who were involved in Master's programs. Our ethnographic field study lasted approximately eight months, with nearly 250 hours spent in the field. We used three methods for studying designers' everyday practices: naturalistic observations, contextual interviews and video recorded collaborative design sessions of designers and design students. In the naturalistic observations, the collaborative aspects of the design studios were studied. Our goal here was to understand the natural circumstances of designers' collaboration, the tools and methods they use, and how the creative process of design is achieved. In this case, one of the authors spent several hours observing designers' work and their collaborative design sessions, by taking notes and pictures. In the contextual interviews, 10 Master's students of industrial design and 5 designers / design researchers were asked to participate in the study. The interview questions were devised to focus on participants' individual ways of designing and on understanding their creative processes. We also wanted to explore how the participants brainstormed, what methods they used to come up with a design concept, how they conveyed ideas to each other, their preferred tools for designing, the perceived advantages of using such tools, and so on. Some of the group design sessions were also recorded to gain detailed insights into

their collaborative processes. In some cases, the first author was also a participant observer, collaborating with design students and recording their design proceedings.

4 ARTFUL SURFACES

Through a qualitative analysis of our field study[1] we explored an interesting aspect of design practice: *the use of studio surfaces*. For us, the conceptualization of studio surfaces is not limited to different physical locations or physical objects and their placement, but is more a phenomenological notion of 'place' that interweaves the material, social and situated view of studio surfaces. Hence, when we talk about design surface, we do not talk about the mere physical space but an appropriated design workplace that has design artefacts such as sketches, posters, drawings and story-boards attached to its surfaces. We introduce a notion of *artful surfaces* (Vyas, 2009). The notion of artful surfaces emphasize on how artfully designers integrate these surfaces into their everyday work and how the organization of these surfaces helps designers in accomplishing their creative and innovative design practices. We discovered three types of artful surfaces: personal, shared, and project-specific. The analysis on surfaces is categorized as a set of functionalities, setup, placement, timeline and ways of using these surfaces. The analysis of different artful surfaces shows that there is something unique about each and every surface, even within these categories. The three classes of surfaces that we will discuss in this section are only generalizations of these surfaces. In the following section we will discuss these surfaces in detail.

4.1 PERSONAL SURFACES

Personal surfaces are created and utilized by individual designers. These surfaces can be in a vertical or horizontal form, or as a mix of both. In the two industrial design departments we observed that personal surfaces were incorporated into office desks, walls, private whiteboards, and other individually used places in design studios. The design artefacts that were commonly seen attached to these surfaces were design sketches, ongoing project-related information, physical models and prototypes, as well as other inspirational and personal information. The artefacts that were associated with these surfaces varied in their materiality, multi-modality, size and temporality. As we observed, the arrangement of these surfaces was quite diverse. Figure 2 shows an example of a personal surface belonging to a design student that is full of different design artefacts. In the example, one can see how cardboards are used vertically to hold different paper based design artefacts such as inspirational images and drawings, where post-it notes are kept as reminders, and some sketches related to ongoing design projects. One can also see a large sheet of paper, at the back of an adjacent pillar, where some design guidelines are written to constantly inform and inspire the designer. On the desk, there are several items that are not directly related to design, with some foam models, design magazines and a stack of design sketches. Presumably, the student has taken his laptop with him while he is away from his desk.

1 This article discusses only a subset of our field study results. Elsewhere we have discussed how physical artefacts support coordinative (Vyas et al. 2008) and experiential (Vyas et al. 2009a) roles and elaborated on the specific practices designers apply to support creativity (Vyas et al. 2009b) in the design studio culture.

Fig 2. Personal Surfaces at a designer's private workspace.

From our study, we observed that one of the main reasons for having personal surfaces was to support work organization. The design artefacts that we commonly found on these personal surfaces had different sets of functionalities ranging from reminders and/or occasional communications with colleagues, to time management for individual projects. These surfaces were generally created and used for a long-term basis. But the arrangement of different artefacts on personal surfaces would change in their lifetime. The placement and setup of personal surfaces was seen to be based on the principle of bricolage (Büscher et al. 2001). Bricolage means accomplishing an activity with whatever available tools and resources at hand. As can be seen in Figure 2, the design student has not used any specialized tools to build his personal surface, rather using whatever resources he could get his hands on. This does not mean that the arrangement is purely ad hoc. In other cases, we observed that these artefacts were also indicative of different phases in the design process: past ideas, the current state, future planning, and so on. During the interviews, one designer commented, "*depending on the phase of the project, I arrange my surroundings. It's important for me to have these artefacts around so that I can register where I am at in the project*". Hence, these design artefacts are also the markers for reminding. Another design student commented, "*the space allows me to organize my work and get reminded what I am doing daily. Also for the purpose of communicating with my peers I can very easily show what I am doing*."

The personal surfaces also included objects from designers' past projects. When faced with a design problem, designers apply knowledge that has been acquired in previous situations to draw references to existing solutions as inputs for their idea generation (Muller and Passman, 1996). Similar patterns were also seen in our findings where designers utilized product samples, catalogues, photographs, slides and so on from their past work and organized them into mood-boards, collages and folders. In many cases, we observed that designers and design students were working on several projects at the same time. Another reason for organizing the personal space in such a way was that unless certain design artefacts are visibly placed on these surfaces, they tends to get 'lost' in the muddle of tasks and parameters that are normally considered simultaneously. For

some of these designers, even a slight or unintended change can lead to problems in their design practices and in some cases once a design artefact is lost from the 'sights' of designers, it would eventually mean that the design artefact may never be retrieved again in a near future. In these cases, such an organization of personal surfaces would lead to quick response from designers in a timely pressured situation.

We now explore the communicative role of these personal surfaces. The purpose of these personal surfaces was to have a quick look at different artefacts on these surfaces and to provide ease to 'bystanders' while communicating on specific design issues. The communicative role of personal surfaces, in fact, leads to utilizing the vertical surfaces such as walls, notice boards and drawing boards, compared to horizontal surfaces such as desks. We observed that certain design artefacts were placed in such a way that others could 'fly through', take in 'at a glance', and 'recognize immediately' what was going on. These selected reminders of the context of a project which is one of many are different in kind from the detailed view needed for completing particular design tasks. During our interview session, a designer commented, "*within a project I need a strong foundation to start with. So, when I am communicating my ideas I need to have several different aspects about my design. Because when the foundation is strong it helps in convincing people. These visual objects around me show my foundational work and work as strong building blocks*."

The construction of these kinds of artful surfaces is not only for the purpose of organizing and accounting for different design projects, it is also about developing new ideas, inspiration and supporting creative thinking.

Richard Coyne (1996) suggests that the design studio culture thrives on the rhetoric of feeling and imagination and organizing personal space with inspirational objects becomes a mundane activity in design practice. Certain organization of personal surfaces allows designers to carry out their design work more effectively. One of the reasons to utilize space in such a way was to elaborate and divide design challenges so that detailed descriptions of different aspects of design could be generated, which in turn would help in resolving a particular situation. The way physical space allows the representation of design tasks can affect designers' reasoning abilities and performance. As one designer suggested, "*I normally try to visualize all the material and data that I collected from my user studies and try to find out patterns and explore design opportunities from this data. I then make my own sketches and models and keep all these in a way that can help me find out new ideas*". In a similar study (Jacucci and Wagner, 2007) it has been shown that material artefacts could have experiential and performative roles and support collaborative creativity in a group of designers. Echoing this, in our work we also discovered some subjective purposes behind using these personal surfaces to express a designer's social identity, personal history and experiences.

Figure 3 represents an example of one such personal surface. A designer organized his workplace by sticking different images, sketches and posters on two of walls at his office. In the following we provide an excerpt of the contextual interview he gave us:

> Designer: "*I like this room, because I can work in a silent environment. I can also turn on music. Sometimes, it is very stimulating to have music in the background. On the other hand, this space allows me to organize my work and get reminded what I am doing on the daily basis.*"
>
> Interviewer: "*What are these images on the wall?*"

Designer: "*I have actually two walls. This is a more dynamic wall* (Figure 3a)*, here you can see a design project that I am currently working on, involving digital photo frames. So, here are some objects related to that project. On this wall things go off and on from time to time.*"

(a) (b)

Fig 3. Walls inside a designer's office, representing inspirational and project specific artefacts.

Interviewer: "*What about the other wall*?

Designer: "*This is* (Figure 3b) *more like the traces of my design carrier. You can see all kinds of projects that I have worked on. Here you see* (by pointing fingers) *a project where I developed a set of personas, in the middle you see my graphic design work that I have done for others. And in the bottom you see other projects that I have worked on"*

Interviewer: "*What about this big poster*?

Designer: "*This is something very special to my heart. It has a spiritual significance in my life and gives me a good feeling when I start my day. And then here are some pictures of people who inspire me."*

One of the walls in this designer's office was more or less static (Figure 3b) and the other was dynamic (Figure 3a) – in a sense that its contents were changed over time. The static wall had artefacts ranging from inspirational sources to information about successful projects – representing a portfolio-type appearance summarizing the designer's interests and achievements. This was an example of creating and displaying 'social identity'. On the other hand, the dynamic wall had information about current projects and the arrangement of these items was a bit messy. In addition, he also kept documents about his plans within

projects on his office desk. Overall, the portability and flexibility of these material artefacts help designers to personalize their work environment.

4.2 SHARED SURFACES

One limitation of a large-sized design organization is the difficulty of having a single physical place for sharing between all the designers. In the two industrial design departments that we studied, it was observed that many surfaces were specifically created and shared amongst a group of co-located designers and design students. The main purpose of using these kinds of surfaces was to share resources and information amongst relevant groups of people. Here, the surface itself was shared but not necessarily the informational and inspirational artefacts on it. However, there were some examples of jointly owned artefacts on these shared surfaces.

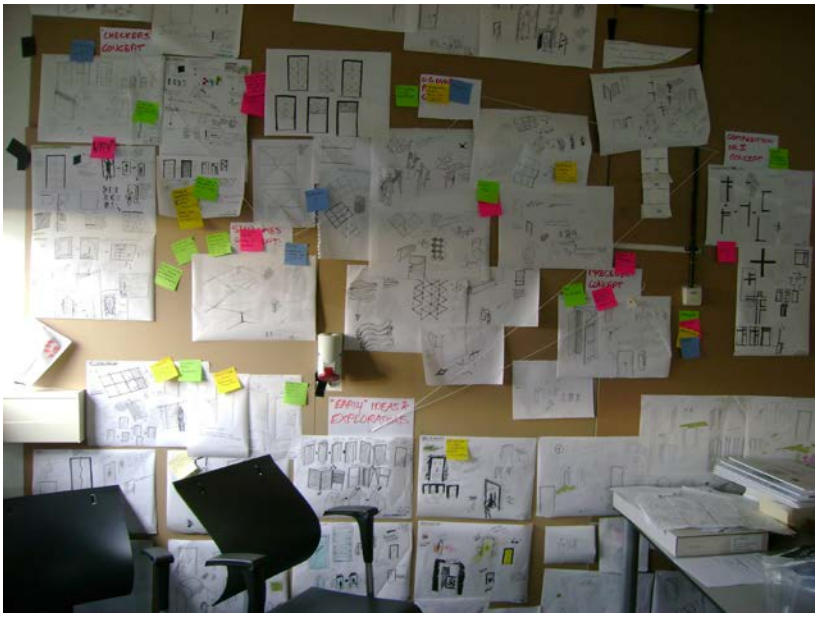


Fig 4. A shared wall, full of sketches, design ideas and other informational artefacts with an added layer of post-it notes and other annotations

These shared surfaces were created and used over a long period of time. They were mainly in the vertical form and very rarely in the horizontal form. Most shared surfaces were large notice boards, clipboards, or physical walls within design studios. They carried both informational and inspirational design artefacts. Typical candidates were informative artefacts such as design sketches, scenarios, use-cases, design principles and guidelines. And inspirational artefacts such as posters, magazine cuttings and related material were also used. Importantly, artefacts like sketches have an inherent nature of sharability. For example, as shown by Baskinger (2008), two-dimensional design sketches are useful not only to develop a design idea, they are also used for envisioning, recording, and narrating ideas, sharing and reflecting both at an individual level as well as at social levels. These design artefacts can be pointed to, talked about or annotated on. Sometime, agreements are reified on artefacts. Design artefacts can function as mediators between different individuals or groups in design. As an example of shared surfaces, Figure 4 shows a part of an office wall cluttered with different artefacts that was shared between 3 -4 design students in a co-located setting. Since these surfaces were used by several people for different purposes, these surfaces had some form of loose

organization. It is documented in several design studies (e.g. Perry and Sanderson, 1998) that design artefacts such as sketches, because of their material properties play an important role in supporting communication between different designers. In Bruno Latour's (1986) terms, these artefacts have the characteristics of immutability and mobility. In other words, these artefacts can work as a persistent form of information as well as a carrier for information that can be moved in or out of the workspace in order to support efficient collaboration amongst different co-workers. Figure 4 shows different labeling and patterning schemes in order to allow clear understanding of the information. It also shows colored post-it notes indicating categories of the artefacts and annotations and comments made by co-inhabitants. In this case, the shared surface is used in a multilayered way and the portability of these artefacts helps (re)arranging them. The intention of creating and using shared surfaces is not necessarily to support coordination of ongoing work but to make others aware of certain ongoing activities.

(a) (b)

Fig 5. Shared Surfaces: at students' workspace (a) and at a designers' workspace (b)

Figure 5 shows two examples of shared space that we captured during our ethnographic field study. The example on the left shows a shared surface artfully created by a group of designers working at a co-located space. Making this a "tea-corner", a group of design students had developed multilayered shared surfaces using wooden panels. The purpose of these surfaces was mainly educational as it included visual design guidelines and best practice schemes. This was an example of a creative use of surfaces and it showed how design students wanted to influence and learn from each other's design knowledge. As Downing (2003) suggested, humans *learn* to value certain things from their communal networks. His notion of *transcending memory* becomes very relevant and important here. For students, when they share their design artefacts such as sketches and posters in a visual public space, it not only helps them to understand the essence and meaningfulness of these artefacts but also helps them imagine the future concepts and design ideas by referring to those original design artefacts. In Figure 5, the example on the right shows a shared surface at a studio of senior designers. On a large common wall, designers kept information about their individual project works, some design posters, their calendars and work schedules and some design prototypes of interactive photo frames. Interestingly, one can see commonly used tools such as printer, cupboards and post boxes aligned with these design artefacts on the shared surface. This in fact increases designers' interaction with the shared surface.

We observed that the physical and public nature of shared surfaces encouraged designers and design students to easily discuss and manipulate the contents incorporated into these shared surfaces. It was seen that these kinds of arrangements were configured and re-configured in a series of different situations to which the designers could react. The examples in Figure 4 and

5 showed a mix of different types of design artefacts placed for different purpose. By mixing narrative elements with descriptions of design ideas a sensibility for the actual context at hand can be supported.

4.3 PROJECT-SPECIFIC SURFACES

These types of surfaces are created by a team of designers when they work on a collaborative project. These surfaces are normally away from designers' personal workspaces. The organization, placement and interaction with these surfaces depend on the kind of project that the designers are working on. The surfaces are developed using movable whiteboards, wooden walls, tables, or more fixed placeholders such as walls. These surfaces hold artefacts that are relevant to a specific project. Informational artefacts related to project definition, project schedule, to-do list, division of work, design concepts and sketches and the like are normally seen on these surfaces. As the project progresses the contents of these artful surfaces emerge or change, but also diverge. Figure 6 shows two examples of project-specific surfaces. Figure 6a shows a workspace made of soft wooden sheets (created for temporary purposes) that carries information about a particular project that deals with designing an Instant Messaging (IM) system. On these surfaces one can find information related to project description and goal, a detailed project schedule, initial sketches, related literature information and possible design concepts. Interestingly, the physical space is intentionally used to create a rich ecology of where a group of designers can completely focus on the project. Figure 6b shows another example of a project-specific surface, where office walls are used to contain information related to a specific design project – designing for bus stop passengers. On the wall one can see images of different types of bus stops, sketches about design ideas, some scenarios and a project schedule.

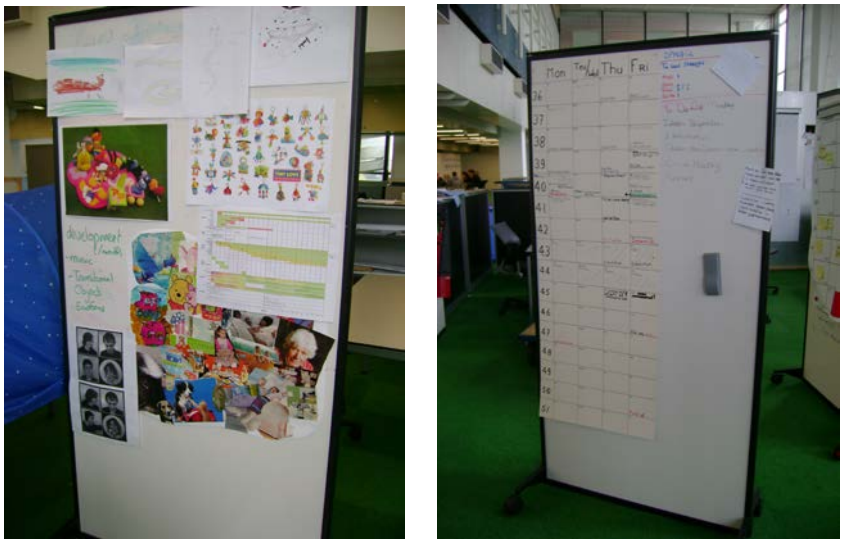
(a) (b)

Fig 6. Project-specific surfaces

An important aspect of project-specific surfaces is its support for planning and organizing ongoing design projects. As can be seen in both of the examples in Figure 6, as a project progresses designers add and change new information to the surface and the new schema of the surface provides an overview of the work-in-progress information. Project-specific surfaces are explicitly intended to capture or summarize the point that a project or part of a project has reached. Such an environment helps during the time when negotiation needs to take place or agreement needs to be obtained from within the design team or from outside parties. The design artefacts on these surfaces can be referred to as "boundary objects" as these artefacts serve as a common ground for supporting group related activities (Star and Griesemer, 1989). Latour (1986) has argued that

visualizations simultaneously support constructing the artefact and staging its performance and understanding by others. In this case, project-specific surfaces serve as a visualization of different activities and form assemblies of artefacts which tell a 'story', such as the story of the design concept or of a particular choice of material and product. On the other hand they enrich the imagination space both of the design team itself and of the audiences to which the project will be presented. Although not all the material created in the design process will be published, it is hard to distinguish at this point between different uses and audiences. All of the representational material will be used by the team itself - creating a representation always means taking a step forward in the common understanding of the design.

Another important use of project-specific surfaces can be seen in Figure 6b, that of maintaining a connection between the rich context of a given problem domain. As we mentioned earlier, designers use contextual and in-situ methods such as ethnographic studies and participatory design to "step into the users' shoes" and get an insight of users' world. And often, it becomes difficult to communicate this experiential and contextual information to co-workers by verbal means. Keeping visual information about study contexts helps designers to ease communication difficulties and help them remind about their work. So, in this example the images of different bus stops and different design sketches related to them can provide contextual sensibilities and allow designers to focus on these contextual cues. Secondly, this also helps in visualizing and coming up with new concepts about their design solutions. The physical space allows people a kind of flexibility by which designers can make connections and associations of design sketches, images and other visual representations. Association of objects helps designers to grasp 'abstract' concepts. Mitchell's (1994) observation that although an image (or idea) may be 'abstract', "language, narrative, and discourse can never – should never – be excluded from it" (p. 226). In this sense, association objects are used for bringing the narrative element in a concept to the fore. And obviously, language, and metaphors are also used for emphasizing specific design qualities.



(a) (b)

Fig 7. Movable whiteboards full of design artefacts

In addition, we also observed that design teams used other forms of horizontal as well as vertical surfaces to support their collaborative design activity within an ongoing project. Figure 7 shows two examples of movable whiteboards, where, in Figure 7a, a group of design students working on developing 'an interactive toy for kids' have kept different concept sketches, time-

schedules and scribbles about desired functionalities. This kind of artful surfaces can be taken to different meeting places, where designers, using pens, can add or change their details. Similarly, Figure 7b is a whiteboard with written information about the project schedule, deliverables, plans and the current status of the project. Indications of changes by co-members of the team can also be seen here. This kind of arrangement allows team members to constructively criticize as well as to build on each other's work throughout the duration of a project.

It can be seen from all these examples, the function of project-specific surfaces is largely productivity-focused. Time-management, scheduling, work progress and division of workload were the most important functions of these artful surfaces. A normal time line of this kind of artful surface is the duration of the project (2 to 6 months) in the case of the students we observed. During the project, these surfaces allow a team to organize, manage and reflect on their work in an effortless, visual manner. The informational artefacts that are attached to these surfaces are used both in a synchronous and an asynchronous manner. During a group meeting, for example, designers can easily refer to or demonstrate particular design phenomena by showing or pointing to specific artefacts. On the other hand, it allows individual members of a team to leave traces of their actions when not all members are present. In both cases, this type of artful surfaces serves as mediators of social coordination.

5 DISCUSSION

In this article, we have described a relatively mundane but inevitably important practice of utilizing design studio surfaces to support everyday design work. We have provided insights into the everyday ways in which designers and design students externalize their design activities through the use of these 'artful surfaces'. Using examples from our ethnographic field study we provided a simple classification of artful surfaces that demonstrated their nature and purposes. In the analysis we considered the qualities of different surfaces and showed how these qualities help designers to incorporate their design-related artefacts into their surfaces in an artful and meaningful way. For example, a two-dimensional sketch can be easily attached to a wall, notes and annotations can be easily written on a whiteboard or 3D sketches can be put on a table for comparison purposes. An emphasis is placed on the manner in which designers continually develop, arrange and integrate different artefacts to create these artful surfaces.

The observations and results discussed in this article provide insights into how design students and design researchers use their physical space as a resource to support their ongoing design activities. It is, however, important to note a limitation that our field study was carried out mainly in the academic environments and focused on the industrial and product design. Hence, it might not be useful to generalize our results to other fields of design (graphics, interior, architecture and so on). Secondly, our intention for carrying out such a field study was focused on generating ideas for designing a tool[2] for supporting designerly communications within the design studio culture. Hence, our overall aim was not to contribute towards the design practice literature but to bring forward an area that is under studied – namely the use of physical space. Our approach can be seen in line with the work of Kruger et al. (2004), where the researchers studied different orientation styles of people while they collaborate on the surface of tables to be able to develop implications for the design of tabletop interfaces. In our work, we do not focus explicitly on collaboration. We illustrate the situated character of different physical surfaces, in other words, how these surfaces

2. One such tool that we have designed using the results of this field study is called Cooperative Artefact Memory (CAM) that allows designers to collaboratively store relevant information on to their physical design artefacts in the form of messages, annotations and web links. A detailed description and use of this tool was presented in a NordiCHI conference in 2010 (Vyas et al. 2010).

are created and used to suit designers' ongoing work and overall situation. It is not the physical and geometrical aspects of the design studio space that we focus on, in fact, we are interested in exploring how the presence, placement and interrelationship of different design artefacts that are attached to the studio space help designers to accomplish their tasks. Key features of the artful surfaces in the design studio context provide support for the assembly, arrangement and manipulation of materials, as well as for acting on them with appropriate tools. The article suggests that the visual nature of these artful surfaces helps designers for the following:

- Establishing a common understanding of a complex design idea or a task
- Organizing and planning design activities
- Describing design in a rich, narrative and metaphorical way
- Preserving the memory of a design project and the 'reasoning' behind it

We also demonstrated that these artful surfaces have a dual nature. On one hand, these surfaces can be seen as *organizing systems* as they help in supporting practical aspects of design practices such as, communicating design ideas to others, reminding of certain work-related issues, and managing projects (e.g. using to-do lists, timetables). On the other hand, these artful surfaces can also be seen as *inspirational systems* as they help in supporting a designer's social identity and work as a carrier of inspirational materials that constantly help designers' creative thinking. In other words, in a subtle way, these surfaces help to (re)shape a designer's professional relationships with other members.

Understanding the role of surfaces becomes especially relevant in the field of HCI, where the desktop metaphor used in the current Graphical User Interfaces (GUIs) is heavily influenced by workplace surfaces (Melon, 1983). Additionally, it has frequently been suggested that material artefacts that populate the workspace ecology need to be taken into account while understanding group work (Heath and Luff, 1992; Shapiro et al. 1994; Hutchins, 1995; Robertson, 1997, Sellen and Harper, 2002). In the case of design practices, different workplace surfaces become an important resource for understanding everyday design activities that take place in design studios and related organizations. We want to point out some issues about the orientation and interaction with these different types of artful surfaces.

- Artful surfaces are created by designers keeping in mind different public and private environments. Of the three types of artful surfaces considered in this article, personal and shared surfaces are used for long-term purposes at places that are within a close proximity of designers' own desks. This allows designers to keep inspirational and private items on these surfaces. On the other hand, project-specific surfaces, because of their shorter lifetime, mainly support team productivity and instrumental knowledge incorporated into them.
- Horizontal surfaces (such as a table) have generally a shorter lifetime than vertical surfaces (such as a wall). Because of limitations of the physical space, horizontal surfaces are mainly used for real-time, instantaneous work. In contrast, vertical surfaces can be easily incorporated into readily available physical places such as office walls.
- Horizontal surfaces are especially useful for synchronous working whereas vertical surfaces are used both for asynchronous and synchronous work. Horizontal surfaces can easily hold three-dimensional objects such as physical models, something vertical surfaces cannot easily allow. During a design meeting a table or a desk can easily help a group of designers to discuss, refer and point to these three-dimensional objects.

- The ways of interacting with vertical and horizontal surfaces differ based on the nature and purpose of these surfaces. Clearly, a relatively large group of people within a close physical proximity can easily discuss and point to certain artefacts on a vertical surface. Whereas with horizontal surfaces designers have to use other ways of interacting with these artefacts. Hence, the orientation and interactions these surfaces afford play a role in how designers use these surfaces in their everyday work.
- This study shows that the kinds of material artefacts incorporated into different artful surfaces are common in most cases. We frequently observed the use of two-dimensional paper-based artefacts such as sketches – representing design ideas, use-cases and interaction mechanisms of products to be designed. Similarly, an organizational artefact such as a project-schedule was seen frequently. Further research is needed to look into these specific artefacts and understand how they help in forming a particular artful surface.

Our work also points to some important design opportunities. The kind of ethnomethodological approach that we applied in our investigation allowed us to understand designers' everyday practices as they happen in the real world. New technologies to support collaborative design should be designed in a way that they can be easily and effortlessly integrated into designers' everyday practice. The current use of surfaces shows that they are placeholders for design artefacts, markers of reminders and carriers of organizational and inspirational objects that designers use in their everyday work. Hence, new technologies to be designed should, in a sense, provide a set of resources for designers to organize their own everyday arrangements and at the same time allow them to be creative and playful with these technologies. Technology should not attempt to institute organizing systems in themselves.

6 CONCLUSIONS

In this article, we have discussed the results of our ethnographic field study in the design studio culture, specifically focusing on the physical surfaces of designers' workspace. Physical space in design studios and its resourcefulness have hardly been studied within the design community (with few exceptions such as (Büscher et al., 1999; Spinelli et al., 2005)). This article shows that a relevant and observable aspect of designers' practice is the way they organize and personalize their working space, especially their surfaces. From the field study we report that workplace surfaces are important for supporting designers' everyday design work, communication within a design team, and play an important role in designers' performance and creativity. Designers keep informational and inspirational artefacts such as sketches, drawings, pictures, and models on their physical surfaces in a way that constantly informs and inspires their design work. Designers' work is visible from these 'artful' surfaces even when the designers are not present. Looking closely into these surfaces allowed us to understand the functions, orientations, timeline and the interaction styles these artful surfaces afforded. Based on these categories, we identified three types of artful surfaces: personal, shared, and project-specific surfaces. The main giveaway of this article is how lessons can be learnt from the current practice of creation and use of these surfaces for designing new display technologies.

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FIGURE COLOR:

All the figures in this article are intended for color reproduction.